IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent Application of

HOWARD et al. — Atty. Ref.: 839-1540

Serial No. 10/825,185 — TC/A.U.: 2858

Filed: April 16, 2004 — Examiner: TERESINSKI, John

For: A CAPACITIVE SENSOR AND METHOD FOR NON-CONTACTING GAP AND DIELECTRIC MEDIUM MEASUREMENT

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January 26, 2007

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

APPEAL BRIEF

Sir:

Applicant hereby appeals to the Board of Patent Appeals and Interferences from the Final Action dated June 13, 2006. A notice of appeal was filed September 13, 2006.

This Brief is timely filed within one-month of a Notice of Panel Decision from Pre-Appeal Brief Review dated December 26, 2006.

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(I) REAL PARTY IN INTEREST

The real party in interest is General Electric Company of Schenectady, New York, a corporation of New York.

(II) RELATED APPEALS AND INTERFERENCES

The appellant, the undersigned, and the assignee are not aware of any related appeals, interferences, or judicial proceedings (past or present), which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

(III) STATUS OF CLAIMS

Claims 1 to 40 are pending of which claims 1 to 17 and 24 to 40 have been finally rejected, and claims 18 to 23 have been withdrawn in view of a USPTO restriction requirement.

(IV) STATUS OF AMENDMENTS

No amendments have been filed since the date of the Final Rejection. A Response that made no amendments to the claims or application was submitted on August 15, 2006.

(V) SUMMARY OF CLAIMED SUBJECT MATTER

The claimed method determines a displacement (such as a gap or width) using a non-contact capacitive sensor. Spec. Paras. 0006-0011. In contrast to the prior art, the claimed method uses a single output single from the capacitive sensor to measure the displacement. Spec. Para. 0019. Rather than using two sensor output signals as done in the prior art, the claimed method uses a high frequency signal to drive the sensor and as a comparative signal to the one sensor output signal. Spec. 0018. The sensor signal output is indicative of the capacitance of the displacement and used to control the gain of an operation amplifier. Spec. Paras. 0016, 0018-19 and 0023. The difference between the amplifier output signal and the high frequency input signal is indicative of the capacitance of the displacement to be measured. Spec. Para. 0024.

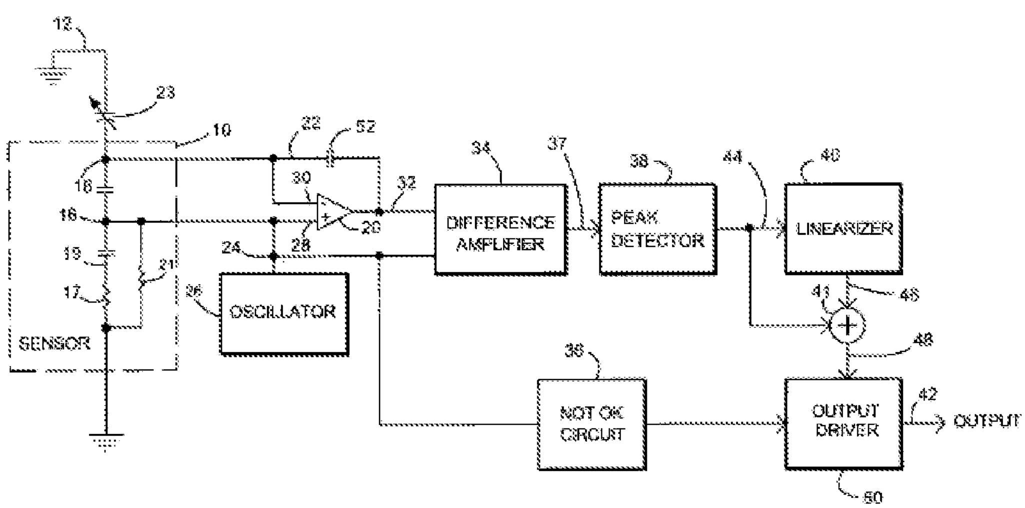
Claims 1, 10, 24 and 28 are independent method claims. Representative claim 1 is:

> 1. A method for non-contact measurement of a displacement between a surface and a capacitive sensor comprised of at least two superimposed conductive plates electrically insulated one from the other and a sensor circuit coupled to the plates, said method comprising:
>
> (a) positioning said capacitive sensor proximate to the surface such that the displacement is a distance of a gap between the surface and one of the plates;
>
> (b) **applying a high frequency signal to the plates;**
>
> (c) **applying the high frequency signal and a signal from a sensor plate of the conductive plates to control a voltage gain of an amplifier in the circuit**, said signal from the sensor plate being indicative of the displacement between the sensor and the surface;
>
> (d) differentiating an output of the amplifier and the high frequency signal, and
>
> (e) **determining a magnitude of the displacement based on the difference between the output of the**

> **amplifier and the high frequency signal**. (Emphasis Supplied).

Method claims 10, 24 and have similar steps for determining a difference between the output of an amplifier and a high frequency input signal, where the amplifier output is dependent on a sensor output signal that governs the gain of the amplifier.

Figure 3 of this application, presented below, shows that the high frequency input signal generated by oscillator 26 is applied to both the sensor 10 and an amplifier 20. Spec. Paras. 0018-25.



An oscillator 26 generates a high frequency input signal that is applied to an active shield plate 16 of the sensor 10. Spec. Para. 0018. The high frequency signal is also applied to the non-inverting input 28 of a operational amplifier (op-amp 20). The inverting input 30 to the op-amp receives an output signal 30 of the sensor plate 18 of the sensor. Spec. Para. 0019. The difference between the output of the operational amplifier

20 and the input signal 24 is indicative of the capacitance 23 of the gap between the sensor and the surface 12. Spec. para. 0019.

The capacitance 23 between the sensor and surface 12 determines the value of the sensor signal 22. Spec. Para. 0023. The gain of the operation amplifier 20 is governed by the sensor output signal 22. Spec. Paras. 0019-20, *see also* dependent claims 3 and 34. The output of the operational amplifier is a high frequency signal that is indicative of the capacitance 23 of the displacement. Spec. Paras. 0021-23. Noise from the sensor circuit is largely cancelled out by using as inputs to the operational amplifier the sensor output signal and the high frequency input signal. Spec. Para. 0020, *see also* dependent claims 2 and 33. Further, the output signal of the operational amplifier and the high frequency input signal have the same cycles and are applied to a difference amplifier that outputs a cyclic cal difference signal. Spec. Para. 0024, *see also* dependent claims 6, 14 and 27.

(VI) GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

I. Whether claims 1-3, 5, 6, 10 to 14, 24 to 29, 31, 33, 34, 36 and 37 are properly rejected for obviousness over Muller (Patent Publication 2002/0070729) in view of Richardson et al (U.S. Patent 4,058,765) should be reversed.

II. Whether claims 4, 7-9, 15-17, 30, 32, 35 and 38-40 are properly rejected for obviousness over Muller and Richardson et al and Tardif et al (US 6,307,385).

(VII) ARGUMENT

The rejection of claims 1 to 3, 6, 10 to 12, 24 to 26, 28, 33, 34 and 37 as being obvious over Muller (Patent Publication 2002/0070729) in view of U.S. Patent 4,058,765 (Richardson et al) should be reversed.

The obviousness rejection should be overturned because it relies on a combination of prior art that does not teach, suggest or provide motivation to form the claimed invention. There is a total lack of recognition in Muller and Richardson et al that a signal sensor output signal from a non-contact, capacitive sensor can be used to measure a displacement. These references teach away from the claimed invention in that they require at least two sensor output signals to measure a displacement.

1. Prior Art Does Not Teach Applying Input Signal And Sensor Plate Signal To Control The Gain Of An Amplifier

Step (c) of claim 1 requires that the high frequency input signal and sensor output signal are applied to control the gain of an amplifier. The high frequency signal is an input signal as is evident from step (b) of claim 1. Claim 1 requires that two signals (one input and one output) are applied to the sensor circuits, in particular to control an amplifier gain. Claim 1, step (e), further requires that the displacement, e.g., gap width, is determined from the difference between the amplifier output and the high frequency input signal. Similarly, independent method claim 10 requires a high frequency input signal and a "signal induced on the sensor circuit by the high frequency signal and sensor plate." These two signals recited in claim 10 are used to determine a width of a medium. Accordingly, the claimed method measures a gap with one input and one output signal.

Muller does not disclose applying a signal from a sensor plate and an input signal to control the gain of an amplifier. Muller applies output signals from two coils 3, 4 to the inputs of a differential amplifier 5. Muller does not control the gain of an amplifier. Muller senses the amount of signal which is capacitively coupled onto a measurement plate. Capacitance between the measurement plate and the target material reduces the coupled signal amplitude which is measured by an operational amplifier (Op Amp) Muller para. 0031. Muller does not suggest controlling the gain of the amplifier with the output signals of either coil or combining an input signal and an output signal to control an amplifier.

The circuit disclosed in Richardson et al does not differentiate the input signal and the output signal of the sensor plate, as is done in the claimed invention. The circuit in Richardson et al applies a pulse train to two separate output capacitances (C_1, C_6), and measures the difference in the charge being held by the two capacitors to determine if the capacitance of one capacitor has changed. Richardson, col. 3, lns. 45-58; col. 4, lns. 11-19. The circuit disclosed in Richardson et al compares the charge held by a sensing capacitor (C3) to the charge held by a reference capacitor C_6. Richardson, col. 4, lns. 20-24, 56. The difference in the charges held by the two capacitors is the signal indicating a general displacement. By disclosing a sensor capacitor and a reference capacitor system (C_1, C_6), Richardson et al teaches away from the system recited in the claims of this application that rely on an output signal and input signal to measure a displacement.

There is no suggestion in the Richardson et al or Muller to substitute the Richardson circuit for the Muller circuit or to combine the references to form the claimed

invention. Muller and Richardson et al do not address the same problem in the same way that is accomplished by the invention. In particular, the invention addresses problems associated with signal noise generated by the electronics processing the sensor signal. *See* Spec. para. 0003. The invention addresses this problem by combining a sensor output signal with an input signal to control the gain of an amplifier. This approach avoids a reference output signal and the associated electronics for processing a reference signal and comparing the reference signal to a sensor output signal. Muller and Richardson et al compare a reference output signal to a sensor output signal. Muller and Richardson et al appear to suffer the same signal noise problem addressed by the present invention and cannot be said to render obvious the solution provided by the present invention.

For the above stated reasons, the combination of Muller and Richardson et al would not have rendered obvious to a person of ordinary skill in the art the methods recited in the independent claims.

2. <u>Patentability of Dependent Claims</u>:

A. Claims 2 and 33:

The invention defined by claims 2 and 33 takes a difference between the output of an amplifier and a reference signal to strip off the reference signal from the measurement and reduce errors caused by changes in the reference signal. The output of the first amplifier is already indicative of the sensor gap. In particular, claims 2 and 33 require differentiating an output of an amplifier and a high frequency signal by "sensing a

difference between a peak of the output of the amplifier and a peak of the high frequency signal." This feature is not taught by Muller or Richardson.

*B. Claims 3 and 3*4:

Claims 3 and 34 require an amplifier that controls the signal on the sensor plate. The AC gain of the amplifier changes as a function of the capacitance between the measurement plate and the target providing an output voltage signal which is indicative of this capacitance. Claims 3 and 34 require: "controlling the gain further comprises applying the signal from the sensor plate and the high frequency signal as inputs to an operational amplifier."

Muller applies the signal from the sensor plate and the high frequency signal to an op amp which is used to take the difference between the two signals and obtain a measurement. Richardson does not suggest retaining Muller's circuit to the extent it applies a high frequency circuit and adding an op amp.

C. Claims 6, 14 and 37:

Claims 6, 14 and 37 require:

> controlling the gain further comprises applying the signal from the sensor plate and the high frequency signal as inputs to an operational amplifier, and wherein differentiating further comprises **applying an output of the operational amplifier and the high frequency signal as inputs to a difference amplifier** which generates a cyclical difference signal indicative of the gap, and applying the cyclical difference signal to a peak detector which generates a signal

indicative of a peak value of the cyclical signal, and wherein said peak value is indicative of the gap. (Emphasis added).

In the sensor embodiment disclosed in this application, an op amp controls the signal on the sensor plate so that there is minimal difference between the signal on the sensor plate and the oscillator driven plate. If there is no difference between these two signals, the sensor will not be sensitive to changes in the cable parameters due to temperature or other environmental conditions.

Muller applies a signal from the measurement plate and a reference signal to an op amp to generate a difference signal. This difference signal is the difference between the signal on the sensor plate and the oscillator driven reference plate. Muller does not teach applying the output of an op amp and the high frequency signal to a difference amplifier. Richardson does not suggest keeping Muller's high frequency circuit and adding portions of its circuit.

The rejection of dependent claims 4, 5, 7 to 9, 13, 15 to 17, 27, 29 to 32, 35, 36 and 38 to 40 as being obvious over Muller and Richardson et al in view of Tardif et al (US Patent 6,307,385) should be reversed.

These dependent claims should be allowed for the same reasons as stated above for their corresponding independent claims.

CONCLUSION

It is respectfully requested that the rejections of this application be reversed and the claims of this application be held to define patentable subject matter.

Respectfully submitted,

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(VIII) CLAIMS APPENDIX

1. A method for non-contact measurement of a displacement between a surface and a capacitive sensor comprised of at least two superimposed conductive plates electrically insulated one from the other and a sensor circuit coupled to the plates, said method comprising:

(a) positioning said capacitive sensor proximate to the surface such that the displacement is a distance of a gap between the surface and one of the plates;

(b) applying a high frequency signal to the plates;

(c) applying the high frequency signal and a signal from a sensor plate of the conductive plates to control a voltage gain of an amplifier in the circuit, said signal from the sensor plate being indicative of the displacement between the sensor and the surface;

(d) differentiating an output of the amplifier and the high frequency signal, and

(e) determining a magnitude of the displacement based on the difference between the output of the amplifier and the high frequency signal.

2. The method as in claim 1 wherein differentiating further comprises sensing a difference between a peak of the output of the amplifier and a peak of the high frequency signal.

3. The method as in claim 1 wherein controlling the gain further comprises applying the signal from the sensor plate and the high frequency signal as inputs to an operational amplifier.

4. The method as in claim 1 wherein controlling the gain further comprises applying the signal from the sensor plate and the high frequency signal as inputs to an

operational amplifier and applying the output of the amplifier as feedback to the signal from the sensor plate.

5. The method as in claim 1 wherein differentiating further comprises linearizing the difference between the output of the amplifier and the high frequency signal.

6. The method as in claim 1 wherein controlling the gain further comprises applying the signal from the sensor plate and the high frequency signal as inputs to an operational amplifier, and wherein differentiating further comprises applying an output of the operational amplifier and the high frequency signal as inputs to a difference amplifier which generates a cyclical difference signal indicative of the gap, and applying the cyclical difference signal to a peak detector which generates a signal indicative of a peak value of the cyclical signal, and wherein said peak value is indicative of the gap.

7. The method as in claim 1 wherein said at least two superimposed conductive plates further comprises the sensor plate, an active shield plate and a passive shield plate, wherein said high frequency signal is applied to the sensor plate and to the active shield plate, and said passive shield plate is insulated from the active shield plate and the sensor plate, and said method further comprises connecting the passive shield plate to a ground via a resistive connection.

8. The method as in claim 1 wherein said at least two superimposed conductive plates further comprises the sensor plate, an active shield plate and a passive shield plate, wherein said high frequency signal is applied to the sensor plate and to the active shield plate, and said passive shield plate is insulated from the active shield plate and the sensor plate, and said method further comprises grounding the passive shield plate and coupling the passive shield plate to the high frequency signal via a resistive conductive path.

9. The method as in claim 8 further comprising monitoring the high frequency signal for a direct current (dc) signal induced by the coupling of the passive shield plate and, when a dc signal is detected, inhibiting the determination of the value of the displacement.

10. A method for measurement of a characteristic of a medium proximate a capacitive sensor comprised of at least three superimposed conductive plates electrically insulated from each other and a sensor circuit coupled to the plates, wherein said plates include a sensor plate, an active shield plate sandwiched between a sensor plate and a passive shield plate, said method comprising:

(a) positioning the capacitive sensor proximate to the medium, such that the medium is capacitively coupled to the sensor plate;

(b) applying a high frequency signal to the sensor plate and to the active shield plate, wherein the medium affects a response of the sensor plate to the high frequency signal;

(c) applying a signal induced on the sensor circuit by the high frequency signal and the sensor plate to control a voltage gain of an amplifier in the circuit, said applied sensor signal being indicative of the medium;

(d) differentiating the output of the amplifier and the high frequency signal, and

(e) determining a magnitude value indicative of a width of the medium based on the difference between the applied signal and the high frequency signal.

11. The method as in claim 10 wherein the medium is a gap between the sensor plate and a surface, and the value is a distance across the gap.

12. The method as in claim 10 wherein the gap is filled with a non-conductive medium and the distance is a thickness of the non-conductive medium.

13. The method as in claim 10 wherein the medium is a fluid and the value is indicative of a dielectric of the fluid.

14. The method as in claim 10 wherein controlling the gain further comprises applying the signal from the sensor plate and the high frequency signal as inputs to an operational amplifier, and wherein differentiating further comprises applying an output of the operational amplifier and the high frequency signal as inputs to a difference amplifier which generates a cyclical difference signal indicative of the gap, and applying the cyclical difference signal to a peak detector which generates a signal indicative of a peak value of the cyclical signal, and wherein said peak value is indicative of the gap.

15. The method as in claim 10 wherein said method further comprises grounding the passive shield plate.

16. The method as in claim 10 wherein said method further coupling the passive shield plate to the high frequency signal via a resistive conductive path and connecting the passive shield plate to a ground via a resistive connection.

17. The method as in claim 16 further comprising monitoring the high frequency signal for a direct current (dc) signal shift induced by a change in the coupling of the passive shield to ground and, when a dc signal shift is detected, inhibiting the determination of the value of the displacement.

18 -23 (Withdrawn)

24. A method for non-contact measurement of a dielectric related characteristic of a medium between a surface and a capacitive sensor comprised of at least two superimposed conductive plates electrically insulated one from the other and a sensor circuit coupled to the plates, said method comprising:

(a) positioning said capacitive sensor proximate to the surface such that the medium is between the surface and a sensor plate of the plates;

(b) applying a high frequency signal to the plates and a dielectric of the medium affects a response signal of the sensor plate to the high frequency signal;

(c) applying the high frequency signal and the response signal from the sensor plate to control a voltage gain of an amplifier in the circuit, said response signal being indicative of the medium between the sensor and surface;

(d) differentiating an output of the amplifier and the high frequency signal, and

(e) determining a magnitude of the displacement based on the difference between the output of the amplifier and the high frequency signal.

25. The method as in claim 24 wherein the medium is a gap between the sensor plate and a surface, and the value is a distance across the gap.

26. The method as in claim 24 wherein the gap is filled with a non-conductive medium and the distance is a thickness of the non-conductive medium.

27. The method as in claim 24 wherein the medium is a fluid and the value is indicative of a dielectric of the fluid.

28. A method for non-contact measurement of a medium proximate to a capacitive sensor comprised of at least two superimposed conductive plates electrically insulated one from the other and a sensor circuit coupled to the plates, said method comprising:

(a) positioning said capacitive sensor proximate to the medium;

(b) applying a high frequency signal to the plates;

(c) applying the high frequency signal and a signal from a sensor plate of the conductive plates to control a voltage gain of an amplifier in the circuit, said signal from the sensor plate being indicative of a property of the medium;

(d) differentiating an output of the amplifier and the high frequency signal, and

(e) determining a magnitude of the property of the medium based on the difference between the output of the amplifier and the high frequency signal.

29. The method as in claim 28 wherein the medium is a fluid and the property is a depth of the fluid.

30. The method as in claim 28 wherein the medium is a solid and the property is a thickness of the solid.

31. The method as in claim 28 wherein the medium is a fluid and the property is a degree of impurities in the fluid.

32. The method as in claim 28 wherein the medium is a solid and the property is a degree of impurities in the solid.

33. The method as in claim 28 and differentiating further comprises sensing a difference between a peak of the output of the amplifier and a peak of the high frequency signal.

34. The method as in claim 28 wherein controlling the gain further comprises applying the signal from the sensor plate and the high frequency signal as inputs to an operational amplifier.

35. The method as in claim 28 wherein controlling the gain further comprises applying the signal from the sensor plate and the high frequency signal as inputs to an operational amplifier and applying the output of the amplifier as feedback to the signal from the sensor plate.

36. The method as in claim 28 wherein differentiating further comprises linearizing the difference between the output of the amplifier and the high frequency signal.

37. The method as in claim 28 wherein controlling the gain further comprises applying the signal from the sensor plate and the high frequency signal as inputs to an operational amplifier, and wherein differentiating further comprises applying an output of the operational amplifier and the high frequency signal as inputs to a difference amplifier which generates a cyclical difference signal indicative of the property, and applying the cyclical difference signal to a peak detector which generates a signal indicative of a peak value of the cyclical signal, and wherein said peak value is indicative of the property.

38. The method as in claim 28 wherein said at least two superimposed conductive plates further comprises the sensor plate, an active shield plate and a passive shield plate, wherein said high frequency signal is applied to the sensor plate and to the active shield plate, and said passive shield plate is insulated from the active shield plate and the sensor plate, and said method further comprises connecting the passive shield plate to a ground via a resistive connection.

39. The method as in claim 28 wherein said at least two superimposed conductive plates further comprises the sensor plate, an active shield plate and a passive shield plate, wherein said high frequency signal is applied to the sensor plate and to the active shield plate, and said passive shield plate is insulated from the active shield plate and the sensor

plate, and said method further comprises grounding the passive shield plate and coupling the passive shield plate to the high frequency signal via a resistive conductive path.

40. The method as in claim 28 further comprising monitoring the high frequency signal for a direct current (dc) signal induced by the coupling of the passive shield plate and, when a dc signal is detected, inhibiting the determination of the value of the displacement.

(IX) EVIDENCE APPENDIX

NONE

(X) RELATED PROCEEDINGS APPENDIX

NONE